PATENT ABSTRACTS OF JAPAN

(11)Publication number : 11-185778
(43)Date of publication of application : 09.07.1999

(51)Int.Cl. H01M 8/02

(21)Application number : 09-365129
(22)Date of filing : 18.12.1997

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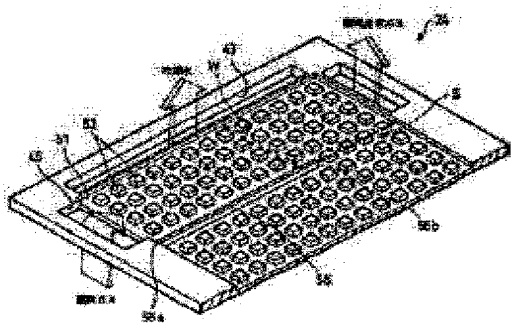
(54) FUEL CELL

(57)Abstract:
PROBLEM TO BE SOLVED: To dissolve problems of an impediment of gaseous diffusion and drying up of an electrolytic film, and to realize more excellent battery performance.
SOLUTION: Plural rectangular parallelepiped projections 53 are formed in a lattice pattern on a stepped surface 51 which is an under surface of a flow path of a separator 24, further two linear rib pieces 55 are arranged so as to divide the width of the stepped surface 51 equally among three. One end parts 55a of the rib pieces 55 are connected with a flat surface of an outer edge of the separator 24, and the other end parts 55b are separated from the flat surface of the outer edge by a prescribed interval S. The stepped surface 51 is divided into three areas by the rib pieces 55, and the areas are communicated each other, consequently a meandering large flow path is formed on the stepped surface 51. Thus, the meandering fuel gas flow path (large passage) is formed by the rib pieces 55, also fuel gas flow paths (small passages) spreading in plural directions are formed by the plural projections 53.



CLAIMS

[Claim(s)]

[Claim 1]In a fuel cell provided with a zygote which pinches an electrolyte membrane by an electrode of a couple, and a passages forming member which forms a channel which passes distributed gas in the direction which contacted this zygote and met a field of this electrode, Said passages forming member is projected from the channel bottom which counters a field of said electrode, and this channel bottom, A fuel cell provided with a rib part which forms said channel of flex shape by dividing into two or more fields a range in which two or more heights which reach a field of said electrode, and said two or more heights on said channel bottom were provided, and changing into the state where each field was opened for free passage.

[Claim 2]The fuel cell according to claim 1 which is rib rows which have arranged a rib piece of linear shape [rib part / said] of 1 or plurality in parallel.

[Claim 3]The fuel cell according to claim 2 which is a size whose width of a clinch portion of said channel formed with said linear shape rib piece is narrower than width of said channel.

[Claim 4]A zygote which pinches an electrolyte membrane by an electrode of a couple, and a gas-passageway formation member which forms a gas passageway which contacts this zygote and passes distributed gas to this electrode, In a fuel cell provided with a circulating-water-flow way formation member which forms a circulating-water-flow way which pours cooling water in the direction which contacted said gas-passageway formation member and met a field of this gas-passageway formation member, The channel bottom to which said circulating-water-flow way formation member counters a field of said gas-passageway formation member, By projecting from this channel bottom, dividing into two or more fields a range in which two or more heights which reach a field of said gas-passageway formation member, and said two or more heights on said channel bottom were provided, and changing into the state where each field was opened for free passage, A fuel cell provided with a rib part which forms said circulating-water-flow way of flex shape.

[Claim 5]The fuel cell according to claim 4 which is rib rows which have arranged a rib piece of linear shape [rib part / said] of 1 or plurality in parallel.

[Claim 6]The fuel cell according to claim 5 which is a size whose width of a clinch portion of said circulating-water-flow way formed with said linear shape rib piece is narrower than width of said circulating-water-flow way.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the fuel cell which has the feature in the distributed gas channel which supplies distributed gas to the zygote which pinches an electrolyte membrane by the electrode of a couple, or the fuel cell which has the feature on the circulating-water-flow way which supplies cooling water in detail about a fuel cell.
[0002]
[Description of the Prior Art]The fuel cell is known as a device which changes into electrical energy conventionally the energy which fuel has directly. While a fuel cell arranges the electrode of a couple on both sides of an electrolyte membrane, usually, He contacts the oxygen containing gas which contacts fuel gas, such as hydrogen, on the surface of one electrode, and contains oxygen on the surface of the electrode of another side, and is trying to take out electrical energy from inter-electrode using the electrochemical reaction which occurs at this time. The fuel cell can take out electrical energy at high efficiency, as long as fuel gas and oxygen containing gas are supplied.
[0003]By the way, in such a fuel cell, the member called the separator which serves both as the channel and collector of these gas is performing supply of the fuel gas to an electrode surface, or oxygen containing gas. As this separator, the thing of the straight-way type provided with two or more linear shape passage grooves is common. Two or more heights are provided and the dividing rib type thing which constituted the channel by the crevice between the heights is also known. Since a channel distributes in the direction of plurality even if one channel is blockaded with what is called flooding etc. that moisture condenses, since gas and produced water can be turned to other channels, the dividing rib type separator excels [produced water] in the diffusibility of gas, and the wastewater nature of produced water.
[0004]
[Problem(s) to be Solved by the Invention]However, in the fuel cell using a said dividing rib type separator, since a channel distributed in the direction of plurality, there was a possibility that the rates of flow of gas might run short. When the rates of flow ran short, the diffusibility of gas was checked, concentration polarization happened and the problem of bringing about the fall of the battery capacity of a fuel cell was produced.
[0005]When a dry gas with humidity low as distributed gas (fuel gas and oxygen containing gas) was used and operation was made, wastewater nature might become excessive by the electrode of the side to which oxygen containing gas is supplied, and the electrolyte membrane might become a dry rise. For this reason, the problem which brings about the fall of battery capacity similarly arose.
[0006]It was made in view of such a problem, inhibition and the electrolyte membrane of the diffusibility of gas cancel the fault used as a dry rise, and an object of this invention is to realize more outstanding battery capacity.
[0007]
[The means for solving a technical problem, and its operation and effect] In the fuel cell provided with the passages forming member which forms the channel which passes distributed gas in the direction which the 1st fuel cell of this invention contacted the zygote which pinches an electrolyte membrane by the electrode of a couple, and this zygote, and met the field of this electrode, Said passages forming member is projected from the channel bottom which counters the field of said electrode, and this channel bottom, It is making into the gist to have a rib part which forms said channel of flex shape by dividing into two or more fields the range in which two or more heights which reach the field of said electrode, and said two or more heights on said channel bottom were provided, and changing into the state where each field was opened for free passage.
[0008]As the above-mentioned distributed gas, it may be fuel gas sent to an anode of a fuel cell here, and may be oxygen containing gas sent to a cathode.
[0009]According to the fuel cell of the above-mentioned composition, two or more heights are

formed on the channel bottom of a passages forming member, and a rib part is formed in a range in which further two or more heights were provided of it. according to this rib part, a range in which two or more heights on the channel bottom were provided was divided into two or more fields, and it changed into the state where each field was open for free passage -- it is and, as a result, a channel of flex shape is formed.

[0010]Although there is no change in width of a channel between heights as compared with a conventional example (dividing rib type separator) by which a fuel cell of such composition provided two or more heights on the channel bottom, width of the whole channel to which a feed hopper and an outlet of distributed gas are connected becomes narrow by having formed a rib part. If width of a channel becomes narrow, since the rate of flow of distributed gas becomes high, it can improve the diffusibility of distributed gas and can reduce concentration polarization. Therefore, according to this 1st fuel cell, improvement in battery capacity of a fuel cell can be aimed at.

[0011]In this fuel cell, since an overall length of a channel was long by having made a channel of distributed gas into flex shape, when a dry gas with humidity low as distributed gas is used, a dry rise of an electrolyte membrane can be prevented. It is because distributed gas is humidified gradually, and a dry rise of an electrolyte membrane can be prevented, so that it will progress downstream, if an overall length of a channel becomes long. Also by this, improvement in battery capacity of a fuel cell can be aimed at.

[0012]In a fuel cell of the above-mentioned composition, said rib part can be considered as composition which is rib rows which have arranged 1 or two or more linear shape rib pieces in parallel.

[0013]According to this composition, a channel of flex shape can be easily made only from using a linear shape rib piece.

[0014]In a fuel cell of the above-mentioned composition, the width of a clinch portion of said channel formed with said linear shape rib piece can still also have composition which is a size narrower than width of said channel.

[0015]According to the fuel cell of this composition, since width of a clinch portion of a channel is that it is ******** from width of a channel, the rate of flow in a clinch portion of a channel can be raised. Therefore, since the diffusibility of distributed gas will become higher by the rate-of-flow rise, concentration polarization can be reduced more.

[0016]A zygote in which the 2nd fuel cell of this invention pinches an electrolyte membrane by an electrode of a couple, A gas-passageway formation member which forms a gas passageway which contacts this zygote and passes distributed gas to this electrode, In a fuel cell provided with a circulating-water-flow way formation member which forms a circulating-water-flow way which pours cooling water in the direction which contacted said gas-passageway formation member and met a field of this gas-passageway formation member, The channel bottom to which said circulating-water-flow way formation member counters a field of said gas-passageway formation member, It is making into a gist to have a rib part which forms said circulating-water-flow way of flex shape by projecting from this channel bottom, dividing into two or more fields a range in which two or more heights which reach a field of said gas-passageway formation member, and said two or more heights on said channel bottom were provided, and changing into the state where each field was opened for free passage.

[0017]According to the fuel cell of the above-mentioned composition, since a channel of cooling water is formed of two or more heights provided on the channel bottom, the diffusibility of cooling water improves and flow distribution of cooling water is equalized. An effect of shape of heights can raise a heat transfer area. Width of the whole channel to which a feed hopper and an outlet of cooling water are connected becomes narrow by having provided a rib part. If width of a circulating-water-flow way becomes narrow, since the rate of flow of cooling water becomes high, it can raise cooling efficiency.

[0018]Therefore, according to this 2nd fuel cell, since improvement in cooling (temperature control) performance can be aimed at, flooding of an electrode and a dry rise of an electrolyte membrane can be controlled, and improvement in battery capacity can be aimed at by extension.

[0019]In a fuel cell of the above-mentioned composition, said rib part can also be considered as composition which is rib rows which have arranged 1 or two or more linear shape rib pieces in parallel.
[0020]According to this composition, a channel of cooling water of flex shape can be easily made only from using a linear shape rib piece.
[0021]In a fuel cell of the above-mentioned composition, the width of a clinch portion of said circulating-water-flow way formed with said linear shape rib piece can also have composition which is a size narrower than width of said circulating-water-flow way.
[0022]According to the fuel cell of this composition, since width of a clinch portion of a circulating-water-flow way is that it is ******** from width of a channel, the rate of flow in a clinch portion of a circulating-water-flow way can be raised, therefore improvement in a cooling capability by the rate-of-flow rise can be raised more.
[0023]
[Other gestalten of an invention] This invention can also take other following modes. In a fuel cell provided with a passages forming member which forms a channel which passes distributed gas in the direction which the 1st mode contacted a zygote which pinches an electrolyte membrane by an electrode of a couple, and this zygote, and met a field of this electrode, Said passages forming member is projected from the channel bottom which counters a field of said electrode, and this channel bottom, A fuel cell equipping a range in which two or more heights which reach a field of said electrode, and said two or more heights on said channel bottom were provided with a rib part which forms spirally a larger channel formed by set of a channel between each heights.
[0024]According to the fuel cell of this 1st mode, heights can raise the diffusibility of distributed gas. The rate of flow of distributed gas can be raised according to a spiral larger channel. These results can aim at improvement in battery capacity of a fuel cell.
[0025]A gas-passageway formation member which forms a gas passageway which the 2nd mode contacts a zygote which pinches an electrolyte membrane by an electrode of a couple, and this zygote, and passes distributed gas to this electrode, In a fuel cell provided with a circulating-water-flow way formation member which forms a circulating-water-flow way which pours cooling water in the direction which contacted said gas-passageway formation member and met a field of this gas-passageway formation member, The channel bottom to which said circulating-water-flow way formation member counters a field of said gas-passageway formation member, It is making into a gist to project from this channel bottom and to equip a range in which two or more heights which reach a field of said gas-passageway formation member, and said two or more heights on said channel bottom were provided with a rib part which forms spirally a larger channel formed by set of a channel between each heights.
[0026]According to the fuel cell of this 2nd mode, heights can raise the diffusibility of cooling water. The rate of flow of cooling water can be raised according to a spiral larger channel. A cooling capability of a fuel cell can be improved and these results can aim at improvement in battery capacity.
[0027]A zygote in which, as for this invention, the 3rd mode pinches an electrolyte membrane by an electrode of a couple, This zygote is contacted and a fuel cell provided with a gas-passageway formation member which forms a gas passageway which passes distributed gas to this electrode, and a circulating-water-flow way formation member which forms a circulating-water-flow way which pours cooling water in the direction which contacted said gas-passageway formation member and met a field of this gas-passageway formation member is characterized by comprising the following:
The channel bottom to which said circulating-water-flow way formation member counters a field of said gas-passageway formation member.
Two or more heights which project from this channel bottom and reach a field of said gas-passageway formation member.

[0028]According to the fuel cell of this 3rd mode, since a channel of cooling water is formed of two or more heights provided on the channel bottom, the diffusibility of cooling water improves

and flow distribution of cooling water is equalized. An effect of shape of heights can raise a heat transfer area. Therefore, according to the fuel cell of this mode, improvement in a cooling capability can be aimed at.

[0029]

[Embodiment of the Invention]In order to clarify further composition and an operation of this invention explained above, an embodiment of the invention is described based on working example below. The polymer electrolyte fuel cell (it is only hereafter called a fuel cell) 10 which is the 1st suitable working example of this invention makes the single cell 20 as a zygote the basic unit, and has the stack structure which laminated the single cell 20. Drawing 1 is an explanatory view which expresses the section of this single cell 20 typically. The single cell 20 of the fuel cell 10 comprises the electrolyte membrane 21, the anode 22 and the cathode 23, and the separators 24 and 25.

[0030]The anode 22 and the cathode 23 are gas diffusion electrodes which constitute sandwich structure on both sides of the electrolyte membrane 21 from both sides. The separators 24 and 25 form the channel of fuel gas and oxygen containing gas between the anode 22 and the cathode 23, sandwiching this sandwich structure from both sides further. Between the anode 22 and the separator 24, the fuel gas flow route 24P is formed, and the oxygen containing gas channel 25P is formed between the cathode 23 and the separator 25.

[0031]Although the separators 24 and 25 form the channel only in one side in drawing 1, respectively, The rib (heights and rib piece) later mentioned to the both sides actually is formed, one side forms the fuel gas flow route 24P between the anodes 22, and other sides form the oxygen containing gas channel 25P between the cathodes 23 with which the adjoining single cell is provided. Thus, the separators 24 and 25 have played the role which separates the flow of fuel gas and oxygen containing gas between the adjoining single cells while forming a gas passageway between gas diffusion electrodes. The rib is formed only in one side to which the separator of two sheets located in the both ends of stack structure touches a gas diffusion electrode, when laminating the single cell 20 and forming stack structure from the first.

[0032]Here, the electrolyte membrane 21 is an ion-exchange membrane of the proton conductivity formed with solid polymer material, for example, fluororesin, and shows good electrical conductivity according to a damp or wet condition. In this example, the Nafion film (made by Du Pont) was used. The alloy which consists of platinum as a catalyst or platinum, and other metal is applied to the surface of the electrolyte membrane 21. Produce the carbon powder which supported the alloy which consists of platinum or platinum, and other metal as a method of applying a catalyst, a suitable organic solvent is made to distribute the carbon powder which supported this catalyst, a proper quantity of electrolytic solutions are added and pasted, and the method of screen-stenciling on the electrolyte membrane 21 is taken.

[0033]The carbon powder which supported the platinum catalyst is produced by the following methods. First, mixing chloroplatinic acid solution and sodium subsulfite, obtaining the solution of a sulfurous acid platinum complex, and stirring this solution, hydrogen peroxide solution is dropped and the platinum particles of colloid are deposited in solution. Next, adding carbon black [for example, Vulcan XC-72 (trademark of U.S. CABOT) and DENKA black (trademark of the Electrochemistry Sub-Division industrial stock type company)] used as a carrier in this solution, it stirs and the platinum particles of colloid are made to adhere on the surface of carbon black. And after separating the carbon black to which platinum particles adhered by suction filtration or pressure filtration out of solution and washing repeatedly by deionized water, it is made to dry thoroughly at a room temperature. Next, a grinder grinds the carbon black condensed at the process of this desiccation, in hydrogen reduction atmosphere, heat at 250 ** - 350 ** for about 2 hours, and platinum on carbon black is returned, and remaining chlorine is removed thoroughly and the carbon powder which supported the platinum catalyst is completed.

[0034]The carrying density (ratio of the weight of platinum on the carbon to the weight of carbon) of platinum to carbon black can be adjusted by changing the ratio of the quantity of chloroplatinic acid, and the quantity of carbon black, and can acquire the platinum catalyst of arbitrary carrying densities. As long as the manufacturing method of a platinum catalyst is a method by which not only the above-mentioned method but sufficient catalytic activity is

acquired, it may be manufactured by other methods.
[0035]Although the above explanation described the case where platinum was used as a catalyst, In addition, the alloy catalyst which consists of an alloy with one kind or two kinds or more of ingredients in platinum whose number is the 1st, the ruthenium whose number is the 2nd and nickel, cobalt, indium, iron, chromium, manganese, etc. can also be used.
[0036]Both the anode 22 and the cathode 23 are formed by the carbon crossing woven with the thread which consists of carbon fiber. In this example, although the anode 22 and the cathode 23 were formed by carbon crossing, the composition formed by the carbon paper or carbon felt which consists of carbon fiber is also preferred.
[0037]The above-mentioned electrolyte membrane 21, the anode 22, and the cathode 23 are unified by thermo compression bonding. That is, the electrolyte membrane 21 which applied the catalyst of platinum etc. is pinched with the anode 22 and the cathode 23, and these are stuck by pressure, heating at 120-130 **. As a method of unifying the electrolyte membrane 21, the anode 22, and the cathode 23, the method [it is based on thermo compression bonding, and also] by adhesion may be used. When pinching the electrolyte membrane 21 with the anode 22 and the cathode 23, between each electrode and the electrolyte membranes 21 A proton conductivity solid polymer solution. If it joins using (for example, Aldrich Chemical and Nafion Solution), it will work as adhesives in the process which a proton conductivity solid polymer solution solidifies, and each electrode and the electrolyte membrane 21 will adhere.
[0038]The separators 24 and 25 are formed by the gas unpenetrated conductive member, for example, the substantia-compacta carbon which compressed carbon and it presupposed gas un-penetrating. The fuel gas flow route 24P is formed on the surface of the anode 22, and the separators 24 and 25 form the oxygen containing gas channel 25P in the both sides on the surface of the cathode 23 of the adjoining single cell, as mentioned already. The detailed composition of such separators 24 and 25 will be explained later.
[0039]In the above, the composition of the single cell 20 which is the basic structure of the fuel cell 10 was explained. carrying out the masonry layer of two or more the separator 24, the anode 22, electrolyte membranes 21, cathodes 23, and separators 25 in this order, as shown in drawing 2 when actually assembling as the fuel cell 10 (this example 3 sets) -- the -- whenever it laminates two or more sets, the one cooling plate 30 is inserted. By laminating two or more sets of combination of such three single cells 20 and the one cooling plate 30, 100 sets of single cells 20 are laminated, for example, and stack structure is constituted by arranging the collecting electrode plate (not shown) formed in the both ends by substantia-compacta carbon, a copper plate, etc.
[0040]The cooling plate 30 is a thing of the straight-way type provided with two or more linear shape passage grooves, and is formed with the same raw material as the separators 24 and 25. The cooling plate 30 plans the temperature control of the fuel cell 10 by carrying out the feeding and discarding of the cooling water from the outside.
[0041]The shape of the separators 24 and 25 of the fuel cell 10 of such composition is as follows. Since the separators 24 and 25 are the same shape, the separator 24 is mentioned as an example and they explain it here. Drawing 3 is a top view of the separator 24. Drawing 4 is a perspective view of the half of the separator 24. As shown in drawing 3 and drawing 4, the separator 24, It is formed as a square tabular member, the hole 41 of the quadrangle of a large caliber (43) is formed near the edge of two neighborhoods which counter, respectively, and the two holes 45 and 46 (47, 48) of the quadrangle of a small caliber are formed near the edge of other two neighborhoods, respectively.
[0042]When the holes 41 and 43 of a large caliber are laminated, they form two cooling water feeding-and-discarding channels which penetrate the fuel cell 10 to a laminating direction. The holes 45 and 48 of two small calibers which counter a diagonal line form two fuel gas feeding-and-discarding channels which penetrate the polymer electrolyte fuel cell 10 to a laminating direction when it laminates, and the holes 46 and 47 of other small calibers form two oxygen containing gas feeding-and-discarding channels similarly penetrated to a laminating direction.
[0043]Inside the flat-surface part of a rim in which these holes 41, 43, 45, 46, 47, and 48 of the separator 24 were formed, The stepped surface 51 which fell by one step is formed from this

flat-surface part, and two or more heights 53 of the rectangular parallelepiped of the width 2 [mm], the length 2 [mm], and the height 1 [mm] which were regularly arranged in the shape of a lattice are formed in this stepped surface 51.

[0044]The two linear shape rib pieces 55 and 56 arranged so that the width of the stepped surface 51 might be equally divided into three are formed in the stepped surface 51. It is the same height 1 as the heights 53 [mm], and the rib pieces 55 and 56 are the width 1 [mm], and their length is shorter than the breadth of the stepped surface 51. The ends 55b and 56b of the other side estrange the rib pieces 55 and 56 only the predetermined distance S from the flat-surface part of the rim by connecting the ends 55a and 56a of an opposite direction to the flat-surface part of the rim of the separator 24 mutually. This distance S is a size equal to the width W of the channel formed with the rib pieces 55 and 56 in this working example.

[0045]The stepped surface 51 will be divided into three fields with the rib pieces 55 and 56, these fields will be open for free passage, and, as a result, one big channel of meandering state (flex shape) will be formed on the stepped surface 51. The both ends of this channel are in contact with the position with the hole 45 arranged at the diagonal line, and the hole 48, and since there is no septum between the end of a channel, and the holes 45 and 48, the channel of the above-mentioned meandering state is connected with the holes 45 and 48. As a result, the fuel gas from the fuel gas feeding-and-discarding channel which consists of the holes 45 and 48 will be supplied or discharged by the above-mentioned channel on the stepped surface 51.

[0046]By composition of such a separator 24, greatly, On the rib pieces 55 and 56, the stepped surface 51, and the surface of the anode 22, the channel (larger channel) of the fuel gas of meandering state is formed, still more finely, it is with the heights 53, the stepped surface 51, and the surface of the anode 22, and the channel (small channel) of the fuel gas distributed in the direction of plurality is formed. The channel of these fuel gas will be equivalent to the fuel gas flow route 24P shown by drawing 1.

[0047]The stepped surface of the above-mentioned stepped surface 51, the heights 53 and the rib pieces 55 and 56, and identical shape, heights, and a rib piece (not shown) are formed also in another side (rear face of drawing 2) of the lamination side of the separator 24. The channel of oxygen containing gas is formed on this stepped surface, heights and a rib piece, and the surface of the cathode 23. The oxygen containing gas from the oxygen containing gas feeding-and-discarding channel formed in the channel of this oxygen containing gas of the above-mentioned holes 46 and 47 is supplied or discharged. The channel of such oxygen containing gas will be equivalent to the oxygen containing gas channel 25P shown by drawing 1.

[0048]It is with the anode 22 and the cathode 23 by passing the oxygen containing gas which contains oxygen in the fuel gas flow route 24P for the fuel gas containing hydrogen to the oxygen containing gas channel 25P, respectively, as the fuel cell 10 of such composition was mentioned above, Electrochemical reaction shown in the following formula (1) and (2) is performed, and chemical energy is directly changed into electrical energy.

[0049]

Cathode reaction (oxygen pole): $2H^{+}+2e^{-}+(1/2)\ O2 \rightarrow H2O$ -- (1)

Anode reaction (fuel electrode): $H2 \rightarrow 2H^{+}+2e^{-}$ -- (2)

[0050]As explained in full detail above, in the fuel cell 10 of this working example, the channel of the fuel gas of meandering state is formed between the hole 45 and the hole 48 which are the feeding-and-discarding mouths of the fuel gas to each cell, and two or more heights 53 are formed in this channel. For this reason, as compared with a conventional dividing rib type separator, the width of the whole channel which connects the hole 45 which is a feeding-and-discarding mouth of fuel gas, and the hole 48 becomes narrow by having formed the rib pieces 55 and 56. If the width of a channel becomes narrow, since the rate of flow of fuel gas becomes high, it can improve the diffusibility of fuel gas and can reduce concentration polarization. Also about oxygen containing gas, by same composition, the diffusibility of gas can be improved and concentration polarization can be reduced.

[0051]In this fuel cell 10, since the overall length of the channel is long by having made the gas passageway into meandering shape as mentioned above, even if it is a case where a dry gas is used for distributed gas, such as fuel gas and oxygen containing gas, the dry rise of an

electrolyte membrane can be prevented. Although the wastewater nature of the produced water tended to become excessive in the conventional rib type separator although water was generated by the electrode reaction, and the electrolyte membrane tended to become a dry rise in the cathode 23, In this fuel cell 10, since distributed gas is gradually humidified so that it will progress downstream, if the overall length of a channel becomes long as mentioned above, the dry rise of the electrolyte membrane 21 can be prevented. Therefore, improvement in the battery capacity of the fuel cell 10 can be aimed at from the operation which reduces the above-mentioned concentration polarization, and an operation of the prevention from a dry rise of the electrolyte membrane 21.

[0052]Since the battery capacity of the fuel cell 10 of the 1st working example and the conventional fuel cell was compared, it explains below. Here, what uses a dividing rib type separator, and two kinds of things which use the what is called Serpentine type separator provided with the passage groove of meandering state were prepared as a conventional fuel cell. Two, the 1st condition using wet distributed gas (in the humidity of fuel gas, the humidity of 100 [%] and oxygen containing gas is 90 [%]) and the 2nd condition using dry distributed gas (in the humidity of fuel gas, the humidity of 100 [%] and oxygen containing gas is 30 [%]), were adopted as an operating condition.

[0053]Drawing 5 is the graph which showed the relation between voltage when the fuel cell 10 and the conventional fuel cell are operated under the 1st [using wet distributed gas] conditions, and current density. Drawing 6 is the graph which showed the relation between voltage when the fuel cell 10 and the conventional fuel cell are operated under the 2nd [using dry distributed gas] conditions, and current density. Among drawing 5 and drawing 6, the curve A shows the relation between voltage and current density about the fuel cell 10, the curve B shows the relation between the voltage about a dividing rib type conventional example, and current density, and the curve C shows the relation between the voltage about a Serpentine type conventional example, and current density.

[0054]As shown in drawing 5, under the condition of wet distributed gas, from the first, as compared with the fuel cell using a dividing rib type separator, the fuel cell with which the Serpentine type separator was used for the fuel cell 10 of the 1st working example covered all the current densities of the time base range, and the characteristic was excellent. In particular, the sag in the high current density field (more than 0.5 [A/cm2]) was small, and improvement in gas diffusion nature was accepted.

[0055]As shown in drawing 6, under the condition of dry distributed gas, as compared with the fuel cell which used the Serpentine type separator, and the fuel cell using a dividing rib type separator, the fuel cell 10 of the 1st working example covered all the current densities of the time base range, and the characteristic was excellent. In particular, under the condition of dry distributed gas, as compared with the dividing rib type separator, since sag was greatly small, improvement in the prevention from a dry rise of the electrolyte membrane 21 was accepted.

[0056]Next, the modification of the 1st working example of this invention is explained. In the 1st working example, although the width (it is equivalent to the distance S between the ends 55b and 56b of the rib pieces 55 and 56 mentioned above and the flat-surface part of a rim) of the clinch portion of the channel of the meandering state formed with the rib pieces 55 and 56 was composition equal to the width W of the channel, it was changed to this and considered as the following composition.

[0057]Drawing 7 is a top view of the separator 90 of a modification. The almost same shape is carried out as compared with the separator 24 of the 1st working example, and, as for the separator 90, that it is different has an overall length of the rib pieces 91 and 92 in the point that only 1.5 [mm] (1.5 times of the width of heights) is long, as compared with the rib pieces 55 and 56 of the 1st working example so that it may illustrate. The depth which is equivalent to the distance Sa between the ends 91b and 92b of the rib pieces 91 and 92 and the flat-surface part of a rim by this composition serves as a size narrower than the width W of the channel formed with the rib pieces 91 and 92.

[0058]Therefore, according to this modification, the rate of flow in the clinch portion of a channel can be raised according to the width of the clinch portion of a channel being narrow. For this

reason, since the diffusibility of distributed gas will become higher, it can raise more improvement in the wastewater nature by the rate-of-flow rise.

[0059]Other modifications are explained below. Although three channels formed with the rib pieces 91 and 92 were composition provided with the width W at equal intervals in the 1st working example and the above-mentioned modification, It changes to this, and in other modifications, as shown in drawing 8, the 1st formed with the rib pieces 96 and 97 thru/or the width W1 of the 3rd channel, W2, and W3 have composition which becomes narrow in order (that is, it has a relation of W1 >=W2 >=W3). The separator 95 of this modification is a size whose width S1 of the clinch portion from the 1st channel is narrower than the width W1 of the 1st channel, and the width S2 of the clinch portion from the 2nd channel is a size narrower than the width W2 of the 2nd channel.

[0060]Therefore, according to this modification, the rise of the rate of flow can be further aimed at with the both sides of that it is so narrow that the width of a channel progresses downstream, and the width of the clinch portion of a channel being narrower than the depth in front of that. For this reason, since the diffusibility of distributed gas will become still higher, it can raise further improvement in the wastewater nature by the rate-of-flow rise.

[0061]The 2nd working example is described below. This 2nd working example is related with the polymer electrolyte fuel cell of the almost same composition as compared with the fuel cell 10 of the 1st working example, and only the shape of the cooling plate 30 is different from the separators 24 and 25 compared with the 1st working example. A separator (not shown) is a dividing rib type thing generally used conventionally. The shape of a cooling plate is as follows.

[0062]Drawing 9 is a top view of the cooling plate 130 used in this 2nd working example. As shown in drawing 9, the cooling plate 130 is formed as a square tabular member, and like the separator 24 of the 1st working example near the edge of two neighborhoods which counter, The hole 131 (133) of the quadrangle of a large caliber is formed, respectively, and the two holes 135,136 (137,138) of the quadrangle of a small caliber are formed near the edge of other two neighborhoods, respectively.

[0063]When the hole 131,133 of a large caliber is laminated, it forms two cooling water feeding-and-discarding channels which penetrate a fuel cell to a laminating direction. The hole 135,138 of two small calibers which counter on a diagonal line forms two fuel gas feeding-and-discarding channels which penetrate a fuel cell to a laminating direction when it laminates, and the hole 136,137 of other small calibers forms two oxygen containing gas feeding-and-discarding channels similarly penetrated to a laminating direction.

[0064]Inside the flat-surface part of a rim in which these holes 131, 133, and 135,136,137,138 of the cooling plate 130 were formed, The stepped surface 151 which fell by one step is formed from this flat-surface part, and two or more heights 153 of the rectangular parallelepiped of the width 2 [mm], the length 2 [mm], and the height 1 [mm] which were regularly arranged in the shape of a lattice are formed in this stepped surface 151. There is no septum between the cooling water feeding-and-discarding channels which consist of the hole 131,133 of the stepped surface 151 and a large caliber, and the cooling water from the hole 131,133 will be supplied or discharged by the channel formed of the heights 153 on the stepped surface 151.

[0065]In the fuel cell of this 2nd working example constituted as mentioned above, the channel of the cooling water distributed in the direction of plurality is formed of two or more heights 153 formed in the cooling plate 130. According to this, the diffusibility of cooling water improves, flow distribution of cooling water is equalized and the effect of the shape of the heights 153 can raise electric heat area.

[0066]Therefore, according to the fuel cell of this 2nd working example, since improvement in cooling (temperature control) performance can be aimed at, the flooding of a gas diffusion electrode and the dry rise of an electrolyte membrane can be controlled, and improvement in battery capacity can be aimed at by extension.

[0067]The relation of the voltage and current density in the fuel cell of this 2nd working example was shown in drawing 10. The curve A shows the relation between voltage and current density about the fuel cell of the 2nd working example among a figure, and the curve B shows the relation between voltage and current density about the conventional fuel cell. Here, the

conventional fuel cell is a fuel cell which uses the cooling plate of the conventional straight-way type provided with two or more linear shape passage grooves.
[0068]As it **(ed) to drawing 10, the fuel cell of the 2nd working example covered all the current density densities of the time base range as compared with the fuel cell of a conventional example, its sag was small, and improvement in battery capacity was accepted.
[0069]The 3rd working example of this invention is described below. Like the 2nd working example, this 3rd working example equips the shape of a cooling plate with the feature, and, other than this, boils it, therefore is provided with the same composition as the conventional polymer electrolyte fuel cell. The cooling plate used with the fuel cell of this 3rd working example applies the shape of the separator 24 explained in the 1st working example almost as it is. Hereafter, a cooling plate is explained in detail.
[0070]Drawing 11 is a top view of the cooling plate 230 used in this 3rd working example. As shown in drawing 11, the cooling plate 230, It is formed as a square tabular member and like the cooling plate 130 of the 2nd working example near the edge of two neighborhoods which counter, The hole 231 (233) of the quadrangle of a large caliber is formed, respectively, and the two holes 235,236 (237,238) of the quadrangle of a small caliber are formed near the edge of other two neighborhoods, respectively.
[0071]The cooling plate 230 of this working example differs in the fluid poured to each holes 231,233,235-238 as compared with the separator 24 of the 1st working example. In this cooling plate 230, when the hole 231,233 of a large caliber is laminated, it forms two oxygen containing gas feeding-and-discarding channels which penetrate a fuel cell to a laminating direction. The hole 235,238 of two small calibers which counter on a diagonal line forms two cooling water feeding-and-discarding channels which penetrate a fuel cell to a laminating direction when it laminates, and the hole 236,237 of other small calibers forms two fuel gas feeding-and-discarding channels similarly penetrated to a laminating direction.
[0072]Inside the flat-surface part of a rim in which these holes 231, 233, and 235,236,237,238 of the cooling plate 230 were formed, The stepped surface 251 which fell by one step is formed from this flat-surface part, and two or more heights 253 of the rectangular parallelepiped of the width 2 [mm], the length 2 [mm], and the height 1 [mm] which were regularly arranged in the shape of a lattice are formed in this stepped surface 251.
[0073]The two linear shape rib pieces 255,256 arranged so that the width of the stepped surface 251 might be equally divided into three are formed in the stepped surface 251. It is the same height 1 as the heights 253 [mm], and the rib piece 255,256 is the width 1 [mm], and its length is shorter than the breadth of the stepped surface 251. The ends 255b and 256b of the other side estrange the rib piece 255,256 only the predetermined distance X from the flat-surface part of the rim by connecting the ends 255a and 256a of an opposite direction to the flat-surface part of the rim of the cooling plate 230 mutually. This distance X is a size narrower than the width Y of the channel formed with the rib piece 255,256 in this working example. Although the width Y of the size relation of this distance X and width Y does not necessarily need to be larger, a difference arises in a cooling capability with that size relation. The difference in this cooling capability is mentioned later.
[0074]The stepped surface 251 will be divided into three fields with the rib piece 255,256 mentioned above, these fields will be open for free passage, and, as a result, one big channel of meandering state (flex shape) will be formed on the stepped surface 251. The both ends of this channel are in contact with the position with the hole 235 arranged at the diagonal line, and the hole 238, and since there is no septum between the end of a channel, and the hole 235,238, the channel of the above-mentioned meandering state is connected with the hole 235,238. As a result, the cooling water from the cooling water feeding-and-discarding channel which consists of the hole 235,238 will be supplied or discharged by the above-mentioned channel on the stepped surface 251.
[0075]By composition of such a cooling water plate, greatly, On the rib piece 255,256, the stepped surface 251, and the electrolyte membrane of a gas diffusion electrode and the surface of an opposite hand, form the channel (larger channel) of the cooling water of meandering state, and still more finely, The channel (small channel) of the cooling water distributed in the direction

of plurality is formed on the heights 253, the stepped surface 251, and the electrolyte membrane of a gas diffusion electrode and the surface of an opposite hand.

[0076]In the fuel cell of the 3rd working example of this invention constituted as mentioned above, by two or more heights 253 formed in the cooling plate 230, it distributes in the direction of plurality and the diffusibility of cooling water of cooling water improves. And with the rib piece 255,256, the width of the whole channel to which the admission port and outlet of cooling water are connected is narrowed, and the rate of flow of cooling water rises.

[0077]Therefore, according to the fuel cell of this 3rd working example, improvement in cooling (temperature control) performance can be aimed at more by the diffusibility of cooling water, and the rate-of-flow rise. For this reason, battery capacity should be excelled more.

[0078]According to the fuel cell of this 3rd working example, since the above-mentioned distance X equivalent to the width of the clinch portion of the meandering state of a circulating-water-flow way serves as a size narrower than the width Y of that channel, it can raise the rate of flow of cooling water more by this clinch portion. Therefore, improvement in cooling (temperature control) performance should be aimed at further, and battery capacity should be excelled further.

[0079]In the fuel cell of this 3rd working example, since the battery capacity of the fuel cell produced by changing the width (it corresponds to the above-mentioned distance X, and X also shows the width of this clinch portion below) of the clinch portion of the circulating-water-flow way mentioned above was compared, it explains below. The 1st composition (in the case of this 3rd working example) that is a size whose width X of the clinch portion of a circulating-water-flow way is narrower than the width Y of that channel as a comparison object here, Three kinds of the 2nd composition that is a size with the width X of the clinch portion equal to the width Y of the channel, and the 3rd composition of that it is a size whose width X of the clinch portion is wider than the width Y of the channel were prepared.

[0080]Drawing 12 is the graph which showed the relation between the voltage about the fuel cell of each above-mentioned composition, and current density. The curve F is a thing about the fuel cell of the 1st composition among a figure, the curve G is a thing about the fuel cell of the 2nd composition, and the curve H is a thing about the fuel cell of the 3rd composition.

[0081]As shown in drawing 11, as compared with other two composition, the fuel cell of the composition of the 1st of a size whose width X of the clinch portion of a circulating-water-flow way is narrower than the width Y of the channel covered all the current densities of the time base range, and the characteristic was excellent. In particular, it turns out that the sag in a high current density field (more than 0.5 [A/cm2]) is small. Next, it is [the width X and the width Y] the fuel cells of equal composition that the battery characteristic is excellent.

[0082]Therefore, also from the result shown in drawing 12, like this 3rd working example, it was accepted that the battery capacity of a fuel cell improves because the width X of the clinch portion of a circulating-water-flow way considers it as a size narrower than the width Y of that channel.

[0083]The modification of said 1st and 3rd working example is explained below. Although the separators 24 and 25 or the cooling plate 230 with which the fuel cell of said 1st and 3rd working example is equipped formed one continuous channel using the rib pieces 55 and 56 (255,256), It is good also as a following-shaped separator or composition of a cooling plate to change to this. That is, it has the rib piece 355,356 in which both ends separate from the flat-surface part of a rim, and are formed on the channel bottom, and is made for a channel to branch via the gap of the rib piece 355,356 and the flat-surface part of both rims in the separator or cooling plate of this modification, as shown in drawing 13. Since the larger channel of the flex shape which has two or more heights 353 can be formed also by this composition between the feed hopper 358 of distributed gas or cooling water, and the outlet 359, improvement in fuel cell performance can be aimed at like the 1st working example and the 3rd working example.

[0084]As other separators or cooling plates of a modification, as shown in drawing 14, it is good also as composition which has two or more heights 453 on the channel bottom, and has the spiral rib part 455 which forms a spiral larger channel on the channel bottom further. Since the larger channel of the spiral shape which has two or more heights 453 can be formed also by this

composition between the feed hopper 458 of distributed gas or cooling water, and the outlet 459, improvement in fuel cell performance can be aimed at like the 1st working example and the 3rd working example.

[0085]As for this invention, although working example of this invention was described above, it is needless to say that it can carry out in the mode which becomes various within limits which are not limited to such working example at all, and do not deviate from the gist of this invention.

[Translation done.]